

A.10 Astro-E2 GUEST OBSERVER – CYCLE 1

1. Scope of Program

1.1 Overview

This program solicits proposals for participation in the NASA program for the conduct of space science observations and subsequent analysis of the resultant scientific data from the joint Japanese-U.S. Astro-E2 X-ray observatory. The primary goal of the Astro-E2 mission is to investigate the nature and physics of astrophysical objects as revealed through detailed observations of their high energy emission. The Astro-E2 mission will emphasize high-resolution, high-throughput X-ray spectroscopy in the 0.4-12 keV range, with particular emphasis upon the 6-8 keV iron K emission band. A broad range of astrophysical objects will be studied, including stars, X-ray binaries, diffuse galactic emission, active galactic nuclei, and clusters of galaxies.

This solicitation is for Cycle 1 of the Astro-E2 Guest Observer Program to be carried out during Phase Ib of the mission. This mission phase will commence on or around September 2005 and last approximately 12 months. The Astro-E2 launch is scheduled for January/February 2005. The mission will be divided into two phases, and Phase I is further divided into four subphases. During Phase I, emphasis will be placed upon observations requiring the cryogenically cooled X-Ray Spectrometer (XRS) instrument. Phase I will last until the XRS cryogen is exhausted (lifetime estimated to be up to ~ 3 years). In Phase Ia, lasting the first six months of the mission, the observatory will undergo on-orbit calibration and performance verification. Also, during this phase, a number of scientific observations will be performed by members of the international Astro-E2 Science Working Group (SWG). During Phase Ib and Ic, each lasting approximately 12 months, observation time will be shared by the SWG and Guest Observers. In Phase Id and beyond, all of the U.S.-allocated observing time will be awarded competitively. The duration of Phase Id is indeterminate due to the uncertainty in the lifetime of the XRS cryogen. During Phase II, which lasts from the time the XRS cryogen is exhausted until the end of the mission, the scientific emphasis will shift to the use of the X-ray Imaging Spectrometer (XIS) and Hard X-ray Detector (HXD) instruments.

NASA will be responsible for allocating the U.S. share of Astro-E2 observing time during the mission via this and subsequent solicitations. Allocation of the Japanese observing time will be the responsibility of the Institute of Space and Astronautical Science of the Japanese Aerospace Exploration Agency (ISAS/JAXA). This Announcement solicits proposals for observations using one or more of the instruments on Astro-E2 during mission phase Ib; proposals for complementary observations or theoretical work that do not directly support the proposed Astro-E2 observations are not solicited. It is anticipated that further opportunities for participation in the Astro-E2 GO program will be announced in subsequent releases of this NRA.

Finally, note that to enable the NASA Office of Space Science to properly evaluate the relevance of proposals submitted to its programs, as well as track its progress towards achieving its goals as mandated by the Government Performance Review Act (GPRA), all research supported by NASA's programs must now demonstrate its relationship to NASA Goals and Research Focus Areas (RFAs) as stated in the latest version of its Strategic Plan (follow links from the Web site <http://spacescience.nasa.gov/>); see also the discussion in Section I of the *Summary of Solicitation* of this NRA. Therefore, all proposers to this program element are asked to state their perception of this relevance in terms of the Goals, Science Objectives, and RFAs given in Table 1 found in the *Summary of Solicitation*. In particular, this program element is designed to help fulfill any of the RFAs for all of the Science Objectives for Goal II of both the science theme "Astronomical Search for Origins" and "Structure and Evolution of the Universe." The appropriate place for this statement of relevancy is in the introduction to the proposal's "Scientific/Technical/Management" section (see Section 2.3.5 in the *Guidebook for Proposers*). The index numbers in this table may be used to identify a specific RFA, for example, "Goal I, Sun-Earth Connection Theme, RFA 1(c)" or "Goal II, Astronomical Search for Origins, RFA 3(b)."

1.2 The Astro-E2 mission

1.2.1 Mission Overview

Astro-E2 is Japan's fifth X-ray Astronomy mission and the third for which the U.S. has provided a significant part of the scientific payload. Its five large-area telescopes focus x-rays from a wide energy range onto four x-ray sensitive Charge-Coupled Devices (CCDs) and a Microcalorimeter. In addition, Astro-E2 carries a non-imaging Hard X-ray Detector (HXD). Astro-E2 will observe a variety of x-ray sources over a very broad spectral band with moderate spatial resolution and both moderate and high spectral resolution, with particular emphasis on the iron K band. Astro-E2 is the first x-ray mission operating between 0.4 and 12 keV combining ~ 6 eV energy resolution with a high-throughput imaging capability. It is anticipated that Astro-E2 will typically perform 1-2 pointings per day. These combined capabilities enable a diverse and exciting program of astrophysical research.

The X-Ray Spectrometer (XRS) is a high resolution imaging spectrometer provided by NASA Goddard Space Flight Center (GSFC), the University of Wisconsin, Japan's Institute of Space and Astronautical Science (ISAS), and Tokyo Metropolitan University. It comprises a 6 x 6 array of microcalorimeters, subtending a 3 x 3 arc minute field of view. The XRS has a spectral resolution of approximately 6 eV across its operating band of 0.4 to 12 keV. It is cooled to a temperature of 65 mK via a three-stage refrigerator. The useful life of the XRS is limited by the cryogenic fluid supply; it is expected to be up to ~ 3 years. During that time, the XRS will be the primary scientific instrument on board Astro-E2.

The four identical x-ray CCD cameras are known as the X-ray Imaging Spectrometers (XIS) and are provided by a hardware team from Kyoto University, Osaka University, Ehime University, Rikkyo University, Kogakuin University, the Massachusetts Institute of Technology (MIT), and ISAS. Each CCD camera head is based upon a single 1024 x 1024 pixel, front-side illuminated CCD chip, manufactured at MIT's Lincoln Lab. The field of view of each camera is 18 x 18 arc minute. The CCD spatial resolution is defined by the X-Ray Telescope (~ 1.8 arc minute half-power diameter); its bandpass is 0.4 to 12 keV. The XIS spectral resolution is ~ 120 eV at 6 keV, and scales as the square-root of the photon energy.

The high throughput X-Ray Telescopes (XRTs) utilize multiply-nested, thin foil, conical mirrors. The XRTs are supplied by the GSFC, Nagoya University, Tokyo Metropolitan University, and ISAS, and provide a spatial resolution of ~ 1.8 arc minute (half-power diameter) and a broad bandpass, 0.1-12 keV.

The Hard X-ray Detector (HXD) is a low background, collimated detector, covering the 10-700 keV band. It is provided by the University of Tokyo, Japan's Institute of Chemistry and Physics (RIKEN), Japan's National Laboratory for High Energy Physics (KEK), Hiroshima University, Saitama University, Kanazawa University, Osaka University, Aoyama Gakuen University, the Stanford Linear Accelerator Center, and ISAS. Its spectral resolution ranges from ~ 9 percent at 662 keV to ~ 30 percent at 10 keV. The detector array consists of silicon PIN diodes (sensitive below 50 keV) and GSO well-type phoswich counters (sensitive above 50 keV). Below 100 keV, fine collimators limit the field of view to 17 x 17 arc minute.

For more information about the instruments, please see the Astro-E2 Technical Description, which can be obtained from the Astro-E2 Guest Observer Facility (GOF) electronically at <http://heasarc.gsfc.nasa.gov/docs/astroe/astroegof.html> or in hardcopy form.

1.2.2 Operations

The Astro-E2 spacecraft weighs 1600 kg and is scheduled to be launched in January/February 2005, from Uchinoura Space Center (USC) in Japan. An ISAS M-V rocket will place Astro-E2 into an approximately circular orbit of inclination about 31 degrees at an altitude of about 550 km. Direct contact between the satellite and the ground station at USC is possible for five orbits per day. The cryogen for the XRS is estimated to last at least 2.5 years, while the other instruments are expected to last about five years. Based upon an anticipated data rate of ~ 1.2 Gigabytes/day, the final mission archive will contain of order 2 Terabytes of raw data.

Astro-E2 operations are managed by Japanese astronomers and engineers at ISAS. They schedule observations, direct the satellite, collect the data, and monitor the health of the spacecraft and its payload. All data from Astro-E2 are copied and sent to the U.S. Astro-E2 GOF at the NASA Goddard Space Flight Center. There they are processed, distributed to U.S. Guest Observers, and archived.

1.2.3 Mission Phases

The Astro-E2 mission consists of two distinct Phases. During Phase I, the mission science will be driven by the XRS. This phase is expected to last up to ~ 3 years. Phase I is further divided into four subphases, Ia, Ib, Ic, and Id. During Phase Ia, which will begin approximately one month after launch and last six months, performance verification and calibration will be carried out. All scientific data collected during this phase will be proprietary to the Astro-E2 Science Working Group (SWG) for one year. During Phases Ib and Ic, observing time will be shared between the SWG and Guest Observers. In Phase Id, which extends from the end of Phase Ic through exhaustion of the XRS cryogen, all of the U.S.-allocated observing time will be awarded competitively. Phases Ib and Ic will each last approximately 12 months; the duration of Phase Id is indeterminate due to the uncertainty in the lifetime of the XRS cryogen.

The observing time allocation during Phase I is as follows:

Phase Ia (6 mos.):

SWG: 100 percent

Phase Ib (12 mos.):

SWG: 25 percent

GO: 75 percent:

32.5 percent for U.S. investigations

37.5 percent for Japanese investigations

5 percent for joint U.S./Japanese investigations

Phase Ic (12 mos.):

SWG: 15 percent

GO: 85 percent:

37.5 percent for U.S. investigations

42.5 percent for Japanese investigations

5 percent for joint U.S./Japanese investigations

Phase Id (duration TBD):

GO: 100 percent:

37.5 percent for U.S. investigations

50 percent for Japanese investigations

12.5 percent for joint U.S./Japanese investigations

Phase II commences when the cryogen used to cool the XRS has become exhausted. The prime scientific instruments then become the XIS and HXD. It is anticipated that this

phase will last at least two years. During Phase II, all of the U.S.-allocated observing time will be awarded via competitive proposals as follows:

Phase II (> 24 mos.):

GO: 100 percent:
30 percent for U.S. investigations
60 percent for Japanese investigations
10 percent for joint U.S./Japanese investigations

This apportionment is similar to that for the Advanced Satellite for Cosmology and Astrophysics (ASCA) mission, a Japanese/US X-ray observatory that ceased operations in July 2000.

1.2.4 General Observing Constraints

The Guest Observer phase of the Astro-E2 mission is anticipated to commence in September 2005. Proposals may be submitted only for projects that may be completed within a period of one year; proposals for multiyear projects will not be considered under this NRA. Investigators whose observing proposals are chosen will receive the data needed for their proposal in a form suitable for analysis. One year later, the data will be placed in a public archive for other interested investigators.

It is anticipated that Astro-E2 will typically perform 1-2 pointings per day. The number of pointings is limited by the long (up to one orbit) settling time required by the attitude control system after a maneuver to a new pointing position. In order to maintain a satellite observing efficiency around 50 percent, this means that the minimum allowable observing time on a particular target is 20,000 seconds. Proposals must take this into account and justify the need for an exposure of this (or longer) duration. In some well-justified circumstances, shorter observations (5-10,000 seconds) might be considered. Also, for targets having limited spatial extent (< 1 degree), it will be possible to specify a "raster" observation: multiple brief pointings at slightly offset locations. The total time on a specific region of sky must still exceed the minimum.

There are no restrictions regarding the amount of observing time or the number of targets requested in Guest Observer proposals. A proposal may be submitted for a single target with a relatively short observation time, or for a larger program involving multiple targets or a greater amount of observing time. All proposals will be reviewed together in the same peer review, and it is expected that a mix of large, medium, and small programs will be selected. It is anticipated that about 70 investigations containing approximately 100 new observations will be selected from proposals received in response to this Announcement.

Time-critical observations, i.e., observations with scheduling constraints, impose a particular burden on Astro-E2 mission planning (for further discussion of such

observations, see the Astro-E2 Technical Description, Section 2, which is available from the Astro-E2 GOF via the World Wide Web at the URL given below). In particular, for “short-lived” phenomena, i.e., phenomena where timing within a spacecraft orbit matters, the ability to observe an event may only be assessed a few weeks prior to scheduling. Too many such time-critical observations would compromise the ability of the mission planning and operations team to effectively schedule the full set of requested observations. As all time-critical observations drive the scheduling process and, therefore, must receive highest scheduling and scientific priority, their total share must be kept relatively small. For Astro-E2, about five percent of the time will be made available for truly time-critical observations (observations requiring a specific day, such as coordinated observations). An additional small time fraction will be made available for less constrained time-critical observations, such as regular visits to a source (i.e., monitoring observations), observations that require a specific orbital phase, and observations requiring a specific roll angle.

A small percentage of observing time (~ 3 percent) has been set aside for Target of Opportunity Observations (TOOs). Observations in this category are those with high scientific importance of rapidly evolving phenomena whose occurrence is not predictable. Prominent examples are supernovae or x-ray transient outbursts. Proposals for TOOs are allowed for Astro-E2. Details regarding the circumstances in which a TOO is “triggered” must be included in the scientific justification and on the target form. TOOs remain reserved only for the observing cycle in effect; if one is not carried out it must be repropose for subsequent cycles. Data from preapproved TOOs will be proprietary to the PI for one year. Note that a proposal cannot include both TOOs and regular observations, even of the same object. Additionally, a mechanism will exist for requesting TOOs for cosmic events unanticipated by any proposal; data for such serendipitous TOOs will be placed immediately into the public archive. Further details about proposing for TOOs, both in response to this announcement and for unanticipated events, can be found in the Astro-E2 Technical Description.

It is anticipated that investigations will be selected covering a variety of topics, including Solar System objects, stars, x-ray binaries, supernova remnants, galaxies, clusters of galaxies, active galactic nuclei, and the x-ray background. Sources to be observed during Phase Ia and those planned for observation by the SWG during Cycle 1, as well as tools for searching the observation database, are available via the World Wide Web from the Astro-E2 GOF homepage at:

<http://heasarc.gsfc.nasa.gov/docs/astroe/astroegof.html>

Proposers should check whether their targets of interest are to be observed. If this is the case, the need for additional observations of those sources must be justified.

1.2.5 The U.S. Astro-E2 Guest Observer Facility

Telemetry, converted to FITS format, together with satellite attitude and position information, will be sent from Japan to the Astro-E2 Guest Observer Facility (GOF) at the NASA Goddard Space Flight Center. The GOF will distribute the data electronically and support U.S. Guest Observers with their analysis of these data. The Astro-E2 GOF is a part of the Office of Guest Investigator Programs at the Laboratory for High Energy Astrophysics, NASA Goddard Space Flight Center, in Greenbelt, Maryland. The GOF can also provide additional technical information if needed for the preparation of proposals. In addition, it: receives, validates, and distributes data and calibrations; provides data analysis software; provides expert help and documentation; and creates the U.S. Astro-E2 archive.

2. Programmatic Information

2.1 Overview of the Review Process

The overall proposal review process will be directed by the Astro-E2 Program Scientist in NASA's Office of Space Science (OSS). A two-stage process will be used. In Stage 1, the scientific and technical merit of the proposed investigation and its relevance to NASA's objectives will be evaluated by a panel of scientific peers convened by NASA. The list of targets provisionally recommended for observation will be consolidated with the Japanese program by a U.S./Japanese committee. Following this consolidation, observers whose proposals are recommended for implementation will be notified by E-mail and asked to submit a proposal to be evaluated in a Stage 2 (cost) review. It is anticipated that the second review will take place within two months after the consolidation meeting. Following the Stage 2 review, those proposers selected for award will be notified of the recommended funding level for their investigation.

2.2 Proposal Submission and Evaluation

IMPORTANT INFORMATION

As discussed in the Summary of Solicitation of this NRA, the Office of Space Science (OSS) is now using a single, unified set of instructions for the submission of proposals. This material is contained in the document entitled *NASA Guidebook for Proposers Responding to NASA Research Announcement – 2004* (or *NASA Guidebook for Proposers* for short) that is accessible by opening URL <http://research.hq.nasa.gov/>, and linking through the menu item "Helpful References," or may be directly accessed online at URL <http://www.hq.nasa.gov/office/procurement/nraguidebook/>.

Note that, due to the need to provide electronic data bases both to NASA Headquarters for overall cognizance of its research programs, as well as to the Astro-E2 GOF for planning of the observations requested by the investigations

to be selected through this program element, proposers are asked to electronically submit proposal materials to two separate Web sites as detailed below.

2.2.1 Who May Propose

The intent of this program is to enhance U.S.-Japanese scientific cooperation, in keeping with the bilateral agreement between the U.S. and Japan. Thus, only Principal Investigators (PIs) affiliated with U.S. institutions and located in the U.S. are eligible to propose for Astro-E2 guest investigations through NASA. The requirement of affiliation with a U.S. institution does not extend to Co-Investigators. It is possible that some targets will be shared by U.S. and Japanese teams, but either a U.S. or a Japanese “Prime” Principal Investigator will always be named.

Commencing in Phase Ib, a small amount of time will be reserved for joint U.S.-Japanese collaborative projects. This observing time will be used primarily to resolve conflicts between the U.S. and Japanese programs or assigned to proposals that exhibit a strong spirit of collaboration between U.S. and Japanese scientists. Individuals wishing to propose a joint U.S.-Japanese collaborative project may request time from either the U.S. or Japanese program. In all cases, proposals involving a US-Japanese collaborative project to observe a common target (or set of targets) must be submitted to either the U.S. or Japanese program, depending upon the national affiliation of the identified PI. A consortium of investigators from the U.S. and Japan may choose to split a large observing program into two separate programs for submission to their respective agencies. In doing so they should also, in the spirit of the above rules, split their source lists; each individual proposal submitted to each agency must be capable of being evaluated on its own merit. The joint U.S./Japanese observing time will be allocated during the merging of the Japanese and U.S. programs and will utilize proposals that have been highly ranked in the U.S. or Japanese peer reviews.

Following selection, the Astro-E2 mission timeline team will deal only with the person identified as the Principal Investigator or lead Co-Investigator. It will be their duty to respond to any questions about detector usage or observational modes. In the event that the data are to be shared by U.S. and Japanese teams, it is expected that the respective Principal Investigators will consult regarding observing configuration issues, although a single primary P.I. will be designated who is responsible for communicating with the mission planning team.

2.2.2 Submission of Proposals to the Astro-E2 Cycle 1 GO Program

NASA will review proposals in a two-stage process. In the first stage, proposals will be evaluated with respect to their intrinsic merit and relevance to NASA’s objectives. Proposals selected in the Stage 1 review will be awarded observing time on Astro-E2 and become candidates for funding subject to the Stage 2 review process. The proposed cost of the investigation will be evaluated in the second stage.

In order to expedite the proposal review process and the timely selection of scientific peer review panels, investigators intending to submit proposals for participation in this

program are asked to submit a Notice of Intent (NOI) to propose by the deadline to the Web address given in this NRA's *Summary of Solicitation*. Note that a NOI submission is not required but is of considerable value in helping NASA plan for an expeditious peer review of proposals.

Prospective proposers to Cycle 1 of the Astro-E2 GO Program must adhere to the following procedures for the submission of Stage 1 and Stage 2 proposals:

Stage 1

- **Electronically submit a *Cover Page/Proposal Summary/Budget Summary*** in compliance with Chapter 2.2 of the *Guidebook for Proposers* at the Web site <http://proposals.hq.nasa.gov>. As budget information is not required until Stage 2, proposers should use a placeholder value of \$1 for the proposed cost of the investigation in the *Budget Summary* in order to allow electronic submission. Print and retain the entire *Cover Page* form for use in Stage 2 (see below).
- **Go to the Astro-E2 website at:** <http://heasarc.gsfc.nasa.gov/docs/astroe/astroegof.html> and complete and electronically submit all required forms. No hard copy submission of the proposal is required. Proposals should include a description of the scientific objectives and a demonstration of the feasibility of the proposed observations and utilization of the unique capabilities of Astro-E2 (with emphasis upon the XRS) for carrying out the investigation. **Note that, due to the nature of prospective investigations within the Astro-E2 GO program, the Scientific/Technical/ Management section of proposals is limited to four pages, with no more than three pages devoted to proposal text, and no more than two to tables and figures. The requirement of a table of contents in the body of the proposal is waived and the budget section is limited to 2 pages.**

Stage 2

Subject to the availability of funds, successful Stage 1 proposers will be contacted by the Astro-E2 Program Scientist and invited to submit a cost proposal for evaluation during Stage 2. Upon notification of selection of a Stage 1 proposal, a proposer must respond as follows:

- Follow the instructions for submitting a budget (not to exceed one year in duration) using either the budget forms found at the Astro-E2 Cycle 1 website or using the proposing institution's own budget format. Preface this with a signed Cover Page from Stage 1 and submit in hard copy to the Astro-E2 GOF.
- As part of the Stage 2 proposal, investigators may request support for correlative observations at other wavelengths, provided that these were

proposed and accepted as part of the Stage 1 proposal. Funding for such correlative studies will be considered only insofar as they directly support a specific investigation using Astro-E2.

2.2.3 Evaluation and Selection of Proposals

Stage 1. Proposals will be evaluated with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers* (excluding cost, to be evaluated in Stage 2 as described below), where it is understood that the Intrinsic Merit of a proposal shall include the following factors:

- the suitability of using the Astro-E2 observatory and data products for the proposed investigation;
- the degree to which the investigation uses Astro-E2's unique capabilities (primary emphasis will be placed upon the degree to which the proposed investigation effectively utilizes the XRS and resulting data products);
- the feasibility of accomplishing the objectives of the proposed investigation with the requested observations, including the degree to which the proposal satisfies Astro-E2 observational constraints; and
- the feasibility of the proposed analysis techniques.

There are two steps in the evaluation of Astro-E2 observation (Stage 1) proposals submitted in response to this Announcement. First, a NASA peer panel will review them according to the evaluation criteria specified above. Second, a Japanese/U.S. merging committee, comprised of members of the U.S. and Japanese Astro-E2 Project team and representatives of the US Guest Observer community (selected from the NASA peer panel) will eliminate the duplication between targets submitted to the U.S. and Japanese programs.

The task of the Astro-E2 merging committee is to integrate the two national observing proposal sets into the observing program. This observing program should be devoid of unnecessary duplications among the nationally defined observing programs. Selections made between overlapping proposals will use the priorities assigned by the NASA and Japanese review committees.

A substantial oversubscription of Astro-E2 observing time is expected. With the above process, most of the reduction in the oversubscription will occur at the national level of proposal review. The most important criterion for the assessment by the national proposal evaluation committees is the scientific merit of the proposed research. However, the feasibility of the proposed observations, as well as observational constraints that may overburden the Astro-E2 mission planning, will also be taken into account in the final selections.

Stage 2. A review team comprised of a subset of the Stage 1 peer evaluation panel will be convened by NASA to review the cost proposals against factor (4) of the evaluation criteria as specified in Section C.2 of the *NASA Guidebook for Proposers*.

Based upon the results of the above reviews, the Astro-E2 Program Scientist will recommend a set of proposals to the Director, OSS Astronomy and Physics Division, for final selection. A total of about \$3.5 M is planned for the support of up to 70 Cycle 1 Guest Investigations of one year duration each.

2.3 Supplemental Information

Further details of the proposal submission requirements and process may be found at the Astro-E2 Website

<http://heasarc.gsfc.nasa.gov/docs/astroe/astroegof.html>,

which includes a detailed mission description; technical information about the Astro-E2 mission, instruments, and feasibility; detailed information regarding proposal submission, evaluation, selection and implementation; and, instructions for completing the required proposal forms.

Technical questions concerning this program element may be directed to the Astro-E2 Guest Observer Facility:

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Programmatic information may be obtained from the Astro-E2 Program Scientist:

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